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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1715

METHODS AND COSTS OF HUSKING CORN IN THE FIELD



MECCHANICAL CORN PICKERS are used chiefly on farms that have relatively large acreages of corn. An average of 96 acres of corn was husked on the home farms with the 1-row pickers included in the study on which this bulletin is based, and an average of 137 acres was husked with the 2-row pickers. The average acreage husked varied a great deal, indicating that other factors were considered in deciding on the method of husking.

The use of the mechanical picker involves the substitution of power and equipment for much of the man labor that is used when husking corn by hand. An average of 5.23 hours of man labor was used in husking an acre of corn by hand on the farms studied, whereas an average of 2.72 hours was used in husking with the 1-row picker and 2.21 hours with the 2-row picker. The horse work was reduced even more, but 1.20 hours of tractor and picker use were added when the 1-row picker was used and 0.80 hour when the 2-row picker was used. To determine the most economical method, therefore, depreciation, interest, and repairs on the tractor and picker must be balanced against the reduction in value of man labor and horse work used in hand husking.

Advantages of the mechanical pickers over hand huskers, aside from the cost considerations, may be summarized as follows: (1) The mechanical picker reduces the labor problem involved in hand husking, (2) husking may be started earlier and completed in a shorter time, (3) the work is easier and more pleasant, and (4) a larger corn acreage can be handled with the available labor.

Disadvantages of mechanical pickers are: (1) The investment in equipment is materially increased; (2) weather conditions, particularly late in the husking season, may make husking unsatisfactory and sometimes impossible; (3) More corn may be left in the field unless great care is taken in operating and adjusting the machine; and (4) the value of the stalk fields for pasture is reduced.

METHODS AND COSTS OF HUSKING CORN IN THE FIELD

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DEVELOPMENT OF CORN-HUSKING MACHINERY

CORN OCCUPIES a greater acreage of land than any other crop, and approximately 80 percent is harvested from the standing stalks, but the development of corn-husking machinery has not kept pace with the development of some other lines of farm equipment. A machine for husking corn in the field was patented in 1850, and during the next 30 years many devices for removing the ears from the stalks were tried. The snapping roller was invented in 1874 and gave promise of being more successful than the earlier devices used to break the ears from the stalks. It received considerable attention for a time, but the development in 1892 of a corn binder embodying principles which have since prevailed, and in 1895 of the self-binding harvester drew attention from the corn husker.

Following 1902 several machines for husking corn appeared on the market, all of the same general type and similar to those sold today except for the source of power. These early machines were drawn by horses, and the husking mechanism was driven from a bull wheel or by a motor mounted on the frame. These machines were effective under favorable conditions, but when the ground was soft husking was unsatisfactory and often impossible.

Considerable expansion in the use of mechanical huskers or, more simply, "pickers", took place soon after the World War. The scarcity and high cost of labor and the increased use of farm tractors stimulated the use of labor-saving machinery. Development of the power-take-off device, by means of which the husking mechanism is driven directly by the tractor, has made the machine more efficient

¹ Acknowledgment is due M. A. Crosby, of the Division of Farm Management and Costs, for assistance in preparing the manuscript.

and satisfactory under adverse ground and weather conditions. With the increased use of the mechanical picker more attention was given to its further development and improvement. The 2-row picker was placed on the market in 1928, and several new types of such machines have appeared since that year.

BASIS AND SCOPE OF THIS BULLETIN

This bulletin shows the elements of cost involved in husking corn by hand, with 1-row pickers, and with 2-row pickers, and the relative importance of these elements of cost, and indicates how the individual farmer can determine the most economical method of husking on his farm. It is based on data obtained from enterprise-cost records kept by 87 farmers who were using mechanical pickers in 1928, and 111 farmers who were operating pickers in 1929,² and from detailed cost records from 122 farms on which the corn crop was harvested by hand.³ In these studies records were obtained showing the cash cost of husking with mechanical pickers and by hand, and the quantities of labor, power, and other materials used. Factors affecting the amount and distribution of costs and the relative advantages of each method are given and are used as a basis for determining the most economical and practicable method of husking on individual farms and under certain conditions.

These studies were conducted in Illinois; but, as studies made in Indiana and Ohio have been considered, it is believed that the data here given are generally applicable to the Corn Belt and to areas outside the Corn Belt if factors affecting the relative costs and advantages are considered.

TYPE AND COSTS OF MECHANICAL PICKERS

Mechanical corn pickers may be divided into two main classes, 1-row and 2-row machines. These classes may be further separated on the basis of source of power, mode of transportation, and method of loading the corn into the wagons. Not all these types were included in this study, for some have appeared on the market only very recently.

Pickers bought before the development of the power-take-off device were all 1-row machines pulled by horses, the husking mechanism being driven from a bull wheel or from an auxiliary engine mounted on the machine. Since the sale and use of this type is now very limited, little attention is given to it here. Records were secured on one hundred and two 1-row power-take-off machines and on sixty-four 2-row power-take-off machines. With one exception, all the power-take-off machines were pulled by the tractor, and on most farms the wagon was pulled alongside the picker by the tractor (fig. 1). Since these records were obtained a picker that is mounted on the tractor, with the wagon drawn directly behind, has become more common (fig. 2). The great advantage of this type is that no

² A cooperative study conducted by the Bureau of Agricultural Economics, U.S. Department of Agriculture, and the Department of Farm Organization and Management, University of Illinois.

³ Records in Champaign and Platt Counties, 1920-28, were kept in cooperation with the Department of Farm Organization and Management, University of Illinois.

hand husking is necessary to open the field. The tank machine, eliminating the necessity for pulling a wagon around the field, is also a recent development (fig. 3). Both the tractor-mounted machine and the tank machine are made in 1- and 2-row sizes.



FIGURE 1.—The power-take-off device for operating the picker, and the hitch by means of which the wagon is pulled by the tractor, have made mechanical pickers more efficient.

The initial cost of the corn picker varies with the make and type. The cost of 1-row power-take-off machines equipped with a wagon hitch averaged about \$425 on the farms studied, and the 2-row



FIGURE 2.—The picker mounted on the tractor that pulls the wagon directly behind it eliminates the necessity for any hand husking to open the field

machines, about \$625. All of the 2-row machines and over one half of the 1-row machines were bought in 1928 or 1929. Nearly all the other 1-row machines, however, were bought in 1925 or later.

THE CORN-HUSKING SEASON

The time when corn husking is begun and the length of the husking season depend to a considerable extent on climatic conditions. Husking usually is started as soon as the corn is dry enough to be put in the crib; frequently the first corn husked is put in several different cribs to prevent heating and spoiling. In central Illinois hand husking normally extends from about the middle of October to the middle of December, with approximately three fourths of the crop in the crib by the first of December. An early frost and a dry fall make it possible to start sooner and make husking by hand easier and faster than is possible during a late fall. In 1928 an early frost and a relatively dry fall permitted over 96 percent of the husking in this area to be done by the last of November. In 1927 the first killing frost was 6 weeks later than in 1928, the rainfall was unusually heavy, and as a result less than one half the husking was done



FIGURE 3.—The tank machine eliminates the necessity for pulling the wagon around the field.

by the 1st of December, and over one fourth of it was delayed until January.

One of the outstanding advantages of the mechanical picker is the possibility of beginning earlier in the season. Machine husking can be started from a week to 10 days earlier than hand husking. This is because a much greater proportion of the silk is removed from the ear by the machines than by hand huskers. Although under unfavorable conditions more husks may be left on the ear by the machine, the husks cause less damage than the silks when put in the crib.

Husking can also be completed much more quickly with equal amounts of labor when the machine is used. Ordinarily the labor on other crops is light during the corn-husking season, but the large acreage of corn grown on many Corn Belt farms and the limited period between the time when the corn can be cribbed and the beginning of winter make it necessary to finish husking in as short a time as possible. The use of the mechanical picker is an alternative to

hiring the extra labor necessary to accomplish this when the corn is husked by hand.

SOURCE OF LABOR USED IN HUSKING CORN

The amount of labor hired for husking corn depends on the acreage of corn husked, the family labor available for husking, and the type of farming. On the farms studied in east-central Illinois, a grain-farming area, 70 percent of the labor in hand husking was hired. In west-central Illinois, a livestock area, the average acreage of corn, per farm is smaller; a greater proportion of the acreage is hogged off or harvested for silage or fodder, and less labor is hired.

The mechanical picker enables the operator to more fully utilize his own and his family's labor and to be less dependent on hired help. On the farms where 1-row pickers were used in 1929, 68 percent of the total labor used in husking was that of the operator or members of his family; on the farms where 2-row machines were used, family labor made up 71 percent of the total. This saving in cost of hired labor must be balanced against the greater overhead cost and the cost of fuel, oil, and repairs involved in machine husking. The amount of labor that must be hired, which is determined by the amount of family labor available in relation to the acreage of corn husked, is therefore an important factor in determining the most economical method of husking on the individual farm.

EFFECTIVENESS OF HUSKING METHODS

The effectiveness of labor and equipment used in husking corn, or the quality of the work done, is usually measured by the quantity of corn left in the field and by the number of husks left on the corn. The corn left in the field may be in the form of whole ears that were missed, or kernels shelled by the snapping and husking rolls. On farms where there are cattle or hogs to pasture the fields after husking, a limited quantity of ear corn left in the field is not a great disadvantage if it can be cleaned up before winter weather prevents. The number of husks left on the corn is not particularly important, especially in the surplus corn-growing areas where most of it is later shelled and sold.

The husking rolls on the earlier machines shelled considerable corn, much of which was lost, but the newer machines save this corn and elevate it into the wagon. According to estimates of the operators, the average quantity of corn left by the 1-row machines was 1.35 bushels per acre and by the 2-row pickers, 2.14 bushels, about 75 to 80 percent of which was ear corn. These estimates are probably low since studies made by the Farm Mechanics Department, University of Illinois, in which corn left by both machines and hand huskers was picked up by hand and measured, shows an average of 5.9 bushels of corn left by the machines and 2.8 bushels by hand huskers. A similar study in Indiana shows an average of 3.38 bushels left in the field by 1-row pickers, 4.92 bushels per acre by 2-row pickers, and 1.24 bushels by hand huskers.

The quantity of corn left in the field by the machine depends on weather conditions, condition of the corn, and experience of the operator in adjusting the machine. Fewer ears are broken from the

stalks and less corn is shelled when the stalks and husks are damp and tough than when they are dry, frozen, or rotten. The loss is, therefore, greater after several hard frosts and freezes or during a dry season—conditions that are favorable for fast and clean hand husking. The ability of the operator to adjust the machine properly, and to change the speed of operation to meet conditions, is important. The snapping rolls must be set close when the stalks are tough to prevent shelling or pulling the entire ear through the rolls. When the stalks are dry or frozen the rolls should be set farther apart to prevent breaking the stalks and elevating them into the wagon. The speed at which the picker is driven must be slower when the stalks are dry or leaning than when they are moist and standing upright. It is almost impossible to do a good job of husking when the stalks are down or leaning badly.

METHODS OF SAVING CORN LEFT IN THE FIELD

On the majority of these farms, corn left in the fields by mechanical pickers was salvaged by livestock or by hand picking. In hand picking, one man with a team and wagon saved an average of 2.7 bushels an hour. In most cases this was done by family labor after the corn was all husked and when there was little other productive work on the farm. Most of the ear corn left by the picker can be saved in this way, but that shelled is lost entirely unless the stalk ground can be pastured by livestock.

RELATION OF METHODS OF HUSKING TO TYPE OF FARM

Hand husking is a common method of husking corn on farms of all sizes and types. The possibility of hiring any number of extra men for hand husking makes this method so flexible as to fit conditions on almost any farm. Labor may be more difficult to obtain, and the cost higher on some farms and in some localities than others, but until recently no other method has proven sufficiently satisfactory to displace the hand husker. The farms from which records were obtained in east-central Illinois are typical of those in the surplus corn-growing areas.

Until recent years mechanical pickers have been most widely used on farms on which a relatively large acreage of corn has been grown or on farms on which other productive enterprises have demanded a large amount of time during the husking season. A survey conducted in 1928 by the Farm Mechanics Department, University of Illinois, showed that mechanical pickers were used on a larger percentage of farms in the dairy area in the northern part of the State than in the beef-cattle and hog area in west-central Illinois, or in the grain area in the east-central part of the State.

There may have been several reasons for this. The dairy enterprise by its very nature necessitates a short day in the field, thus making it essential to use labor-saving equipment. Then much of the hand husking is done by transient labor from areas south of the Corn Belt. The number of such laborers in the dairy area in northern Illinois usually is much lower than in the surplus-corn areas in east-central Illinois. This uncertainty of labor supply and the consequent higher rates in the dairy area induced the earlier adoption

of machines for husking corn there. As some corn in the beef-cattle and hog area is hogged off, and some is cut and shocked, the regular labor force can handle a greater part of the corn to be husked from standing stalks without difficulty.

However, more mechanical corn pickers are now in use in the important surplus-corn-producing areas, where the former high cost of labor for hand husking made such labor-saving machinery popular with many farm operators. Nearly all the information on corn pickers was secured in such an area, where large farms on which 50 percent or more of the crop land is annually planted to corn are common.

The farms on which 1-row pickers were studied averaged 293 acres in size; those on which 2-row machines were used averaged 350 acres. Four 1-row machines were each owned jointly on two farms averaging 162 acres in size, and eight 2-row machines were owned jointly on farms averaging 201 acres.

ACREAGE OF CORN

An average of 142 acres of corn was grown on the farms on which 1-row machines were used and an average of 172 acres on those on which 2-row machines were used. Not all of this was husked in the field, nor was all that was husked in the field picked by machines. On some farms a small part was cut for silage or fodder or was hogged off. Usually a small part must be husked by hand to open the field for the machine, the amount depending on the size and shape of the fields. Extra men were hired to hand-husk 12 percent of the corn grown on the farms on which 2-row machines were used, and 26 percent of that where 1-row pickers were used. On some farms these extra men were hired late in the season when weather conditions and the condition of the corn made machine husking unsatisfactory; on others they were hired in the beginning in order to finish as quickly as possible.

An average of 96 acres of corn was husked by the 1-row machines on the home farms and an average of 137 acres by 2-row pickers. In addition, an average of 31 acres was husked on outside farms by each of five 1-row machines and an average of 60 acres by each of twelve 2-row machines. The total acres husked per season with 1-row pickers ranged from 32 to 275 acres, and with the larger machines from 30 to 338 acres. More than 80 acres each were husked by 70 percent of the 1-row pickers, however, and more than 120 acres each by 74 percent of the 2-row machines. It is evident that although the acreage of corn is important in selecting the method of harvesting, other factors were also considered on many of these farms.

SUPPLY OF LABOR, POWER, AND CAPITAL

At least 2 men are necessary for efficient machine picking, 1 operating the tractor and picker and 1 hauling and cribbing the corn. The number varies with the equipment. When a wagon hitch is used with the tractor to pull the wagon in the field and elevators are used to crib the corn, 1 man with 1 team and 2 wagons can haul the corn without delaying the 1-row picker, and with 2 teams and 4 wagons can usually do the same with the 2-row machines (fig. 4). Additional

men are necessary if the distance to the field is great or if 1 man must drive the team while loading, or if the corn is scooped off by hand at the crib (fig. 5). A few operators of 1-row pickers had no one to



FIGURE 4.—One man with 2 teams and 4 wagons can haul corn from the field, leading 1 team behind the first wagon, and crib it as fast as one man can husk with a 2-row picker.

haul and crib the corn; they loaded the wagons and then stopped the picker while they hauled and cribbed the corn. They used less total man labor in husking but the rate of husking was much slower as the picker was idle a considerable part of the time.

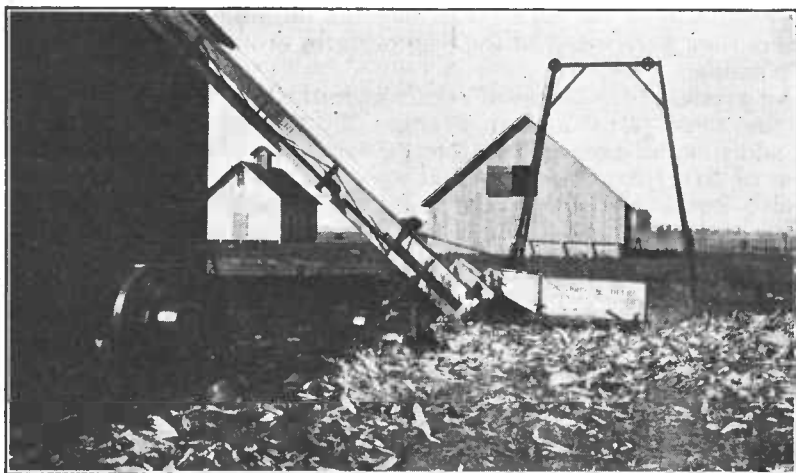


FIGURE 5.—A wagon hoist and extra power to operate the elevator are often necessary when one man hauls the corn from the field.

A tractor is necessary in using the modern power-take-off type of picker. Two-plow tractors were used to pull 71 percent of the 1-row pickers and 40 percent of the 2-row pickers; larger tractors were used on the others. Under most conditions the small tractor is

satisfactory for the 1-row picker but does not have sufficient power to pull the 2-row picker and wagon when the ground is wet. On one farm, where a larger tractor was not available, 2 small tractors were used when the ground was wet, 1 pulling the picker and 1 the wagon. This permitted a faster rate of travel than if the wagon were pulled by a team.

The investment of capital necessary in the purchase of the mechanical picker is relatively large and, over a period of time, interest and depreciation on the picker must be considered as a farm-operating cost. Since these costs, once incurred, are fixed, the acreage of corn husked is an important factor in determining their relative importance. When spread over a large acreage, the proportionate part of these fixed costs to be borne by each acre or each bushel sinks to a low figure. Lack of capital or credit prevents many farmers, especi-

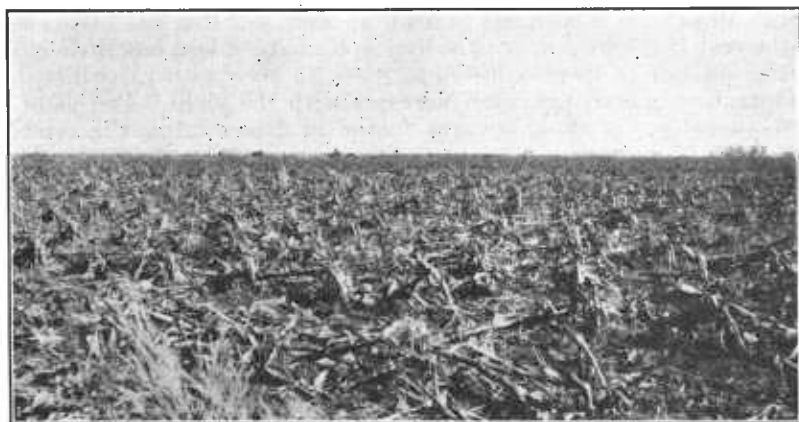


FIGURE 6.—Field of corn that has been husked by machine. Mechanical pickers break the stalks down more than hand huskers, but husking is completed earlier, giving more time for pasturing before winter weather.

ally tenant operators, from using mechanical pickers. On other farms alternative uses for the available capital may determine the method of husking corn.

OTHER FACTORS

Some land owners have objected to the use of mechanical pickers in the belief that the corn left in the field materially reduces the amount of rent they receive. On farms where the stalk fields are pastured extensively the machines are often objected to because the stalks are broken down more than when the corn is husked by hand so that much of the pasture value is lost (fig. 6). It is true that the stalks are broken down more, but it should be remembered that the earlier date at which husking is completed permits longer pasturing before severe winter weather.

CAPACITY OF LABOR IN HUSKING CORN

Two men in average corn can husk twice as much corn with a 1-row picker and three times as much with a 2-row machine, in an

hour, as two men can husk by hand. The average rate of husking corn by hand in central Illinois is about 9 bushels an hour per man. In this study 2 men with a 1-row machine husked an average of 36 bushels per hour, and 2 men with a 2-row machine averaged 56 bushels per hour.

The rate of husking corn by hand depends on the yield of corn, on weather conditions, on type and quality of corn, and on the skill, ambition, and endurance of the husker. In machine husking the rate varies with the yield of corn, weather conditions, the condition of the machine, and the ability of the operator to keep the machine properly adjusted and going steadily.

An increase of 10 bushels in the yield of corn is found to result in an increase of about 0.8 bushel in the quantity husked in an hour by hand. This is an important factor since labor is much easier to get, and usually at a lower rate per bushel, when the yield of corn is high. More time is required to husk an acre, but this has little effect on the cost if the husker is paid by the bushel. Yield has little effect on the amount of time required to husk an acre with machines, but the quantity husked per hour increases with the yield. The yield of corn, therefore, is an important factor in determining the relative economy of hand or machine methods of husking.

Mechanical pickers may be operated at highest speed when the cornstalks are damp and tough. When the stalks are dry or frozen, and consequently very brittle, more ears are broken off and left on the ground, more corn is shelled by the snapping rolls, and more husks are left on the ears. Machine husking, therefore, is often slow and unsatisfactory under weather conditions which are ideal for hand husking. Conditions favoring machine husking usually prevail during the early part of the husking season, and the possibility of covering a large acreage soon after the corn is dry enough to be cribbed and before freezing weather often determines the degree of success of the mechanical picker and the acreage that can be handled in a season. Because of these limitations of the mechanical picker during the latter part of the husking season, hand huskers are often hired on farms where a large acreage of corn must be husked.

LABOR, POWER, AND EQUIPMENT USED IN HUSKING

The use of mechanical huskers involves the substitution of mechanical power and equipment for a large part of the man labor and horse work used where corn is husked by hand. An average of 5.23 man-hours, 10.19 horse-hours, and 5.10 hours of wagon use were used per acre in husking by hand on the farms studied. On farms on which 1-row pickers were used an average of 2.72 man-hours, 3.28 horse-hours, 2.86 wagon-hours, and 1.20 each of tractor- and picker-hours were used per acre, and on farms using 2-row pickers the quantities used per acre were 2.21 man-hours, 2.86 horse-hours, 1.97 wagon-hours, and 0.80 each of tractor- and picker-hours (table 1). The 2-row pickers used approximately 19 percent less man labor and 13 percent less horse work in husking an acre than did the 1-row pickers.

TABLE 1.—*Labor, equipment, and materials used per acre in husking corn by hand and by machines*

Item	Hand husking on 122 farms	One hundred and two 1-row pickers	Sixty-four 2-row pickers
Yield of corn, per acre..... bushels..	48.8	43.0	45.0
Labor and equipment used:			
Man labor..... hours..	5.23	2.72	2.21
Horse work..... do.....	10.19	3.28	2.86
Wagon..... do.....	5.10	2.86	1.97
Picker..... do.....		1.20	.80
Tractor..... do.....		1.20	.80
Materials used:			
Gasoline ¹ gallons..		.78	.90
Kerosene ¹ do.....		1.55	.64
Oil ¹ do.....		.11	.08
Grease..... pounds..		.11	.04

¹ About 22 percent more fuel was used when 3-plow tractors were used with either 1- or 2-row pickers than when 2-plow tractors were used, but the size of tractor made little difference in the amounts of labor and power used.

To husk an acre of corn requires approximately 2.50 miles of travel with a 1-row picker and 1.25 miles with a 2-row machine. The average of 1.20 hours used in husking with a 1-row picker, and 0.80 hour with a 2-row picker represent an average rate of travel of 2.08 and 1.56 miles an hour, respectively. The time as given includes that spent in oiling, greasing, and making adjustments but does not include time spent in repair work.

The ability of the operator to care for and adjust the machine properly is important, and the amount of time spent on this work varies greatly. The machines should be given a thorough greasing and inspection twice a day, and some parts should be oiled even more frequently. Neglect of these essentials is likely to slow up the work. The yield of corn has little effect on the time required to husk an acre if the machine is in proper condition. On the farms studied less time was used per acre on farms on which a large acreage of corn was husked, but this probably was because of effective management in keeping the machines going rather than because of the larger acreage of corn per farm.

The number of men used in husking with mechanical pickers depends on the distance the corn is hauled, the method of pulling the wagon in the field, and the method of unloading at the crib. On many farms more men were used than necessary in hauling and unloading, frequently only because the help was available. Unless the speed of the picker is increased this abundance of labor does not increase the rate of husking.

FUEL AND OIL

The quantities of fuel and oil used vary with the size of the picker, the size of the tractor, and other factors such as adjustment of the picker and tractor and condition of the corn and ground. Average quantities of fuel and oil used for husking an acre are about one third less with a 2-row picker than with a 1-row machine (table 1). The distance the 2-row machine must travel is, of course, only one half as great as that which a 1-row picker must travel in harvesting

an acre, but more power is required to operate the larger machine, and because of lack of power the larger machine often is operated at a lower speed than the 1-row machine.

About 22 percent more fuel is used in operating either the 1- or the 2-row picker with a 3-plow tractor than with a smaller tractor. The rate of travel is no greater in pulling the 1-row picker with a large tractor than with a small tractor but a somewhat higher speed is often possible when so pulling the 2-row machine. This advantage of the larger power unit is most apparent when the ground is soft.

COSTS OF HARVESTING CORN BY VARIOUS METHODS

The practical problem for the individual farmer is to select the method that is best and most economical under his particular circumstances. The system of farming that he is following, the acreage and yield of corn, the supply of regular labor available, and the prevailing level of prices and cost rates are factors that must be considered. The question is largely a matter of the relative costs involved in the different methods of doing the corn-picking job. These costs on an acre basis as averages for the farms in this study, are set forth in table 2.

TABLE 2.—*Cost of husking corn by hand and by machines, based on average quantities of labor, equipment, and materials used in eastern Illinois, seasons of 1928 and 1929*

Item	Hand husking on 122 farms	One hun- dred and two 1-row pickers	Sixty- four 2-row pickers
Acres husked per farm or per machine.....	98	105	159
Yield per acre..... bushels.....	48.8	43.0	45.0
Average cost per acre: ¹			
Hired labor.....	\$1.88	\$0.34	\$0.26
Operator's and unpaid family labor.....	.81	.75	.63
Horse work.....	1.43	.46	.40
Tractor:			
Depreciation.....		.48	.39
Interest.....		.25	.21
Fuel and oil.....		.42	.29
Picker:			
Depreciation.....		.45	.44
Interest.....		.15	.13
Repairs.....		.09	.01
Shelter.....		.03	.02
Wagon use.....	.10	.06	.04
Elevator use.....	.24	.21	.23
Extra power at elevator.....		.05	.09
Total.....	4.46	3.74	3.14
Combined and classified costs per acre: ²			
Direct cash costs.....	1.88	.90	.65
Unpaid costs.....	2.24	1.24	1.05
Depreciation.....	.34	1.20	1.10
Interest.....		.40	.34
Total.....	4.46	3.74	3.14

¹ The following rates for labor, power, and materials were used to determine the cost of husking in 1928 and 1929: Man labor, 5½ cents per bushel for hand husking and 40 cents an hour for day labor; horse work at 14 cents an hour; tractor use, including depreciation, interest, and repairs, at 90 cents an hour for 3-plow tractors, and 50 cents an hour for 2-plow tractors; fuel, 13.4 cents per gallon for kerosene, 16.4 cents for gasoline, and oil at actual cost; wagon use at 2 cents per hour; elevator use at one-half

Two separate sets of figures are given for each method of husking. In the upper part of the table are given the various items of average cost such as hired labor, family labor, and tractor use, as determined in the study for hand husking, 1-row machine husking, and 2-row machine husking. In the lower part of the table these costs are combined and classified under several heads: (1) Direct cash costs, (2) unpaid costs, (3) depreciation, and (4) interest. Before discussing these costs, let us examine the classification of costs from the point of view of the significance of the different kinds of costs in helping to answer the farmer's question of how he ought to harvest his corn.

CLASSIFICATION OF COSTS

Under Direct Cash Costs are included all expenditures of money directly chargeable to the operation in question. For example, the fuel, oil, and hired labor used in running the mechanical corn picker, or the hired labor paid for by the bushel in the case of hand husking, are direct cash costs chargeable to the job of picking the corn. Under all circumstances, such costs have a direct influence upon the decision of the farmer.

The term "unpaid costs" is used to include those costs which are contributed by the farmer himself, by his family, or by the permanent elements in his farm organization that are used in the operation concerned—corn picking in this case—but for which he does not, at least immediately, pay out any money. Proprietor and family labor and the use of work stock regularly kept on the farm and which otherwise would not be in use during corn harvesting, are included in this group. The additional use of these resources does not necessarily increase the cost of operating the farm, and therefore these costs bear a distinctly different relationship to the problem of determining how to harvest corn from that of the direct cash cost.

Depreciation is similar to the unpaid costs, and might logically be included with them on farms where the equipment is already owned. Depreciation represents a cash outlay made in some previous period, but once the equipment is bought, depreciation does not represent an immediate cash outlay incurred directly and exclusively for the operation concerned. Furthermore, some depreciation takes place through weathering and obsolescence even when equipment is

(Footnote ¹ continued)

cent per bushel. Depreciation on the picker was calculated according to the following formula:

$$\frac{\text{Cost of machine} \times \text{acres husked}}{\text{Average life of machine (acres)}} = \text{annual depreciation}$$

Interest on the picker was charged at 6 percent on the average valuation during its expected life, determined as follows:

$$\frac{\text{Cost of machine} \times \text{average life of machine (years)} + 1}{\text{Average life of machine (years)} \times 2} = \text{average valuation}$$

The average life of the 1-row picker was estimated at 10 years, or 950 acres; that of the 2-row machine at 8 years, or 1,400 acres. Repairs on the pickers were charged at actual costs. In comparing the cost of repairs on the 1- and 2-row pickers it should be remembered that all the 2-row machines were 1 or 2 years old while many of the 1-row machines were 3 or 4 years old. Shelter charges were estimated at \$4.20 a year for the 2-row pickers and \$3.50 for the 1-row machines.

² Direct cash costs include hired labor, fuel and oil, and repairs on the picker. Unpaid costs include operators and other unpaid family labor, horse work, and shelter for the picker. Depreciation includes depreciation on the tractor and picker, and use of wagon and elevator. Interest includes interest on the tractor and picker.

not used. As depreciation is an important cost factor in the use of mechanical pickers and tractors, it seems well to separate it (table 2).

Finally there is the interest which might also be considered an unpaid cost but which, for the sake of making the picture a little clearer, is put in a separate classification. The purchase of new equipment increases the amount of capital on which interest must be paid or from which some return may be expected. But the additional use of equipment already on the farm does not increase the interest charge on that machine.

USE OF COSTS IN SELECTING A METHOD OF HUSKING CORN

Table 2 may be used in an effort to find a basis for the decision as to the most economical method of harvesting corn. In terms of the average costs, as found in this study for the year in question, the table shows that it cost \$4.46 per acre to have the corn husked by hired pickers at the rate of 5½ cents per bushel. It cost \$3.74 per acre at the prevailing prices of gasoline, oil, and other cost elements to have it picked by a 1-row mechanical picker, or \$3.14 by a 2-row machine. These gross acre costs include all of the classes of costs already discussed.

They do not necessarily give a conclusive answer to the farmer's question as to how he should harvest his corn, nor that he should, under those circumstances, pick his corn with a 2-row machine, since the total costs by that method are lowest.

In the first place, current conditions with reference to cost rates have changed drastically since these figures were gathered. First of all, the farmer must take these changes into account. In the second place, the answer partly depends on whether he is considering the use this year of a machine he has previously bought and has on his farm ready for use, or whether he must buy a machine in order to use the mechanical method.

Suppose that he has a machine and is trying to settle whether he should use it this year. The gross acre-cost figures would indicate that he is particularly fortunate if he has a 2-row picker; that the next cheapest method would be a 1-row picker; and that the most expensive method would be to hire it done by hand at bushel rates.

But he should look at the items showing the different classes of costs. In a period like the present it is particularly important that cash costs be kept at a minimum. The "direct cash cost" item also shows that he would have to pay out the most cash to have it picked by hand and the least by having it picked by a 2-row machine. On the basis of immediate cash expenditure, therefore, it is obvious that if a man has a picker he should use it. Here, again, current rates of cost must be considered rather than those that obtained when this study was made.

But suppose now that he is trying to decide whether to buy a picker. He must then consider not only the cash costs but depreciation and interest on the new equipment, and depreciation on other equipment, because all of these additional costs are still within his control. Looking again at the average figures in table 2, it is evident that if he includes cash costs, plus depreciation, and interest, all of which will be affected by his decision to buy or not to buy a picker, the cost for hand picking is \$2.22 per acre; for 1-row-machine

picking, \$2.50; and for 2-row-machine picking, \$2.09. So far as these figures go, therefore, it would still appear to be most economical to buy a 2-row machine instead of hiring the corn picked by hand at bushel rates. But, again, he must think of the current conditions. During 1931 and 1932 he could probably have found hand huskers who would work at the low rate of 3 cents per bushel and, although the cost of day labor would also have been less, the other items such as gasoline, oil, and the original purchase price of machinery would not have fallen nearly so much. A refiguring of these costs on the basis of current rates would make a much less favorable showing for the mechanical huskers.

But these costs are not the only considerations he must take into account in making his decision. Even though it looks as though he might well buy a picker, he may not have the cash or credit with which to buy it, or he may be able to use his available cash or credit to greater advantage in some other way. He also may not wish to invest his limited capital in a machine like the corn picker, that will bring its returns and services only over a period of several years and the economic advantage of which depends so much on the relative prices of labor and materials.

Moreover, he has not yet considered the so-called unpaid costs which are mainly family and proprietor labor. Such costs enter into the consideration in a way quite different from direct-cash costs, and even depreciation and interest. Their importance in his decision rests largely on the value of the alternative uses he may have for this labor. It is possible that he may use his own labor more than normally by prolonging the corn-husking season, thus avoiding not only the buying of a machine but the hiring of hand huskers as well. The wisdom of this depends upon a number of considerations such as the alternative use he may have for this unpaid labor and the risk of loss he is running by prolonging his corn-harvesting season into the winter months. It is true that costs representing unpaid labor must be met in the long run if farming is to be profitable, but in the immediate situation the farmer frequently uses this unpaid labor, without the hope of getting a full normal return for its use, merely because if he did not use it he would be getting nothing for it, and he wisely decides it is better to get something, although it is a small return, than to get nothing.

Thus it seems clear that cost figures alone are inadequate as a basis for determining the best method of husking corn or for the performing of any other farm operation. They are important, however, in that they furnish indispensable information which, together with the knowledge of the operator and information from other sources, forms a basis for the farmer's judgment.

FACTORS AFFECTING COSTS OF HUSKING

To illustrate further the considerations that have been discussed and to indicate how the individual farmer may determine which of the available corn-harvesting methods he will use on his own farm table 3 is given. The estimated quantities of labor, power, and other materials necessary, and the costs of husking corn on one farm by different methods, are shown. The costs are first shown itemized

and are then grouped according to the classifications discussed. (See table 2.)

TABLE 3.—*Estimated quantities and costs of labor, power, and materials for husking 112 acres of corn by different methods and under specified conditions*

[Average yield of 50 bushels per acre; only the operator is regularly on the farm at this season, but labor is available at 5½ cents per bushel for hand husking or 40 cents an hour for day labor]

Item	Hand husking		1-row picker		2-row picker	
	Quantity	Cost	Quantity	Cost	Quantity	Cost
	<i>Bushels</i>	<i>Dollars</i>	<i>Hours</i>	<i>Dollars</i>	<i>Hours</i>	<i>Dollars</i>
Hired labor.....	3,850	211.75	135	54.00	90	36.00
Operator's labor.....	1,750	96.25	150	60.00	100	40.00
	<i>Hours</i>					
Horse work.....	1,204	168.56	270	37.80	360	50.40
Tractor:						
Depreciation.....				1 97.20		1 64.80
Interest.....				24.30		16.20
			<i>Gallons</i>		<i>Gallons</i>	
Fuel.....			302	40.47	186	24.92
Oil.....			11	8.25	9	6.75
Picker:						
Depreciation.....				1 50.10		1 50.00
Interest.....				14.02		21.12
Repairs.....				10.00		10.00
Shelter.....				3.50		4.20
Wagon use ³		12.04		5.40		7.20
Elevator.....		28.00		28.00		28.00
Total.....		516.60		433.04		359.59
Combined and classified costs:						
Direct-cash costs.....		211.75		112.72		77.67
Unpaid costs.....		264.81		101.30		94.60
Depreciation.....		40.04		180.70		150.00
Interest.....				38.32		37.32

¹ Estimated cost of use for 135 hours.

² Estimated cost of use for 90 hours.

³ Wagons used 602 hours for hand husking, 270 hours with 1-row picker, and 360 hours with 2-row picker,

This is a 200-acre farm with 120 acres in corn yielding 50 bushels per acre. Typical of many grain farms in the Corn Belt, only the operator is on the farm regularly at this season of the year, but hired help is available for hand husking at 5½ cents per bushel and day labor at 40 cents per hour. A 3-plow tractor and the normal number of work horses are on the farm. In order to open the fields for the mechanical husker, about 8 acres will be husked by hand, so costs are estimated for the remaining 112 acres of corn.

If the corn is to be husked by hand, the operator may estimate that he can husk 35 acres, or 1,750 bushels, leaving 77 acres, or 3,850 bushels, to be husked by hired help. The farm is so arranged that the corn must be hauled only a short distance to the crib and, with the elevator, 1 man with 1 team and 2 wagons can haul the corn without delaying the 1-row picker and with 2 teams and 4 wagons, without slowing up the 2-row machine. With the 1-row picker he can hire 1 man and husk the entire 112 acres in about 17 days. With 1 man and the 2-row machine he will use about 12 days.

Under these conditions the estimated cost of husking the corn by hand is \$4.61 per acre; the cost with a 1-row picker is \$3.87 per acre; and with a 2-row machine, \$3.21.

But these figures are not conclusive evidence of the economy of the mechanical picker on this farm. There is no other work on the farm at this season at which the operator may profitably use his time and the horses. These items of unpaid costs, therefore, may be disregarded for the present. Direct cash costs also show the machines to be more economical than hand husking, amounting to \$1.89 per acre when husked by hand, \$1.01 per acre when husked with a 1-row picker, and \$0.69 when a 2-row machine is used. When depreciation on the tractor, picker, and wagon, and elevator costs, and interest on the picker are added to the cash costs, however, the cost of hand husking is \$2.25 per acre, the cost with a 1-row picker is \$2.96, and with a 2-row machine is \$2.36 per acre. If only cash costs and depreciation are considered (as might be feasible when a mechanical husker is owned and the question is whether to use it or not), the cost of husking with the 2-row machine is slightly lower than the cost of husking by hand.

The economy of using a mechanical picker on this farm is at least questionable. On some farms other enterprises will demand sufficient time during this season so that a picker will reduce materially the amount of labor that would be hired if the corn were husked by hand. On some farms the regular labor can be used profitably during the time saved through the use of the machine. The regular labor and the picker may be used in doing custom work by which the overhead cost on the home farm is reduced and the farm income increased. In some cases the final decision may be made on the basis of the farmer's likes and dislikes.

The costs of husking on this farm as estimated in table 3 assume certain conditions to exist. How are the relative costs of husking by different methods affected by variations in these conditions? The effect of certain changes is shown in table 4.

TABLE 4.—*Effect of variation in certain factors on the cost of husking 112 acres of corn shown in table 3*

Item	Cost per acre as estimated in table 3			Case 1. Effect of changes in number of men regularly on the farm			Case 2. Effect of changes in yield of corn			Case 3. Effect of changes in labor rates			Case 4. Effect of changes in corn acreage		
Acres of corn.....	112			112			112			112			50		
Yield of corn per acre bushels.....	50			50			30			50			50		
Regular men on farm number.....	1			2			1			1			1		
Labor rates:															
Hand husking per bushel.....cents.....	5½			5½			5½			3			5½		
Day labor per hour cents.....	40			40			40			25			40		
	Hand	1-row picker	2-row picker	Hand	1-row picker	2-row picker	Hand	1-row picker	2-row picker	Hand	1-row picker	2-row picker	Hand	1-row picker	2-row picker
Classified costs per acre:															
Direct cash costs.....	\$1.89	\$1.01	\$0.69	\$1.03	\$0.52	\$0.37	\$0.94	\$1.01	\$0.69	\$1.03	\$0.83	\$0.57	\$0.82	\$1.02	\$0.70
Unpaid costs.....	2.36	.91	.85	3.22	1.39	1.17	.82	.90	.62	1.97	.70	.72	3.43	.93	.89
Depreciation.....	.36	1.61	1.34	.36	1.61	1.34	.23	1.51	1.21	.36	1.61	1.34	.36	1.72	1.89
Interest.....		.34	.33		.34	.33		.34	.33		.34	.33		.50	.57
Total.....	4.61	3.87	3.21	4.61	3.86	3.21	1.99	3.76	2.85	3.36	3.48	2.96	4.61	4.17	4.05

Suppose, as in case 1 in table 4, there are 2 men on the farm regularly instead of only 1. The amount of hired labor necessary for hand husking is greatly reduced, and none is required in husking with the machine. The total cost is not affected since the unpaid labor is figured at hired labor rates, but the cash costs are materially lower, particularly in the case of hand husking where labor makes up a large part of the total cost. The cash costs are still in favor of the mechanical pickers, but when depreciation is considered with cash costs, hand husking is by far the most economical method.

In case 2, table 4, a yield of 30 bushels per acre is assumed, with other conditions as they are in table 3. With the lower yield per acre the number of bushels that can be husked per hour by hand is reduced, but more acres can be husked during the season, thus reducing the proportion that is husked by hired labor. As the yield of corn has little effect on the number of acres husked with the machines, the only difference in the cost of husking is the lower charge for the elevator. When the total costs, or when cash costs plus depreciation, are considered, hand husking is by far the most economical method under these conditions. Hand husking is more economical than husking with the 1-row picker when cash costs alone are considered.

The lower rates for labor which now prevail have been mentioned as an important factor in determining the relative costs of husking by different methods. In case 3, table 4, the costs are estimated under conditions when hand huskers can be secured for 3 cents a bushel and day labor for 25 cents an hour. The cost of hand husking is reduced more, proportionately, than the cost of machine husking because of the greater importance of labor in determining the total cost. The total cost of hand husking is lower than using the 1-row picker but the cash cost is higher.

In case 4, it is assumed that only 50 acres of corn are husked. The total cost per acre of hand husking in this case is the same as when 112 acres were husked since the overhead is reduced directly with the acreage. The cost when the machines are used is higher than on the larger acreage since much of the overhead cannot be reduced. The total cost per acre on the 50-acre job is slightly higher when the corn is husked by hand, but cash costs are lower than when a 1-row machine is used, and when depreciation is considered the costs are greatly in favor of hand husking.

No attempt is made here to indicate all the different situations that might influence the relative costs of husking by different methods. The examples given will serve to show how the individual farmer can make some estimate of the relative costs on his farm, taking into account the factors that have been mentioned as well as any others that he believes should be considered.